INTERVERTEBRAL DISC HERNIATION WITH INTRADURAL MIGRATION OF FRAGMENTS

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The paper presents analytical review of the literature on the problem of surgical treatment of patients with intradural migration of intervertebral disc hernias and a clinical case of intradural herniated disc in the lumbar spine. Despite advances in neuroimaging and modification of methods and surgical techniques, this pathology is rarely diagnosed preoperatively. Its surgical treatment involves considerable technical difficulties and is associated with high rate of revision operations. The study material included abstracts of articles from the PubMed database and articles published in *The Journal of Bone and Joint Surgery, Spine, European Spine Journal,* and other journals over the past 15 years.
Key Words: herniated disc, intradural migration of the intervertebral disc fragment.

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Intervertebral disc herniation with intradural migration of fragments is a rare pathology. According to the literature data, its prevalence varies within 0.2–2.2 % of the total number of hernias of all localizations [9, 16]. A total of 39,111 patients with degenerative pathology of the spine had been consulted at Ya.L. Tsivyan Research Institute of Traumatology and Orthopaedics

in the period of 2007–2015. Surgical aid for herniated intervertebral discs was provided to 5,435 patients, 1 (0.02 %) of whom was diagnosed with intradural migration of the hernial fragment at L3–L4 segment.

The first mention of transdural migration of intervertebral disc herniation dated 1942 [Cit. according to: 7]. Since that, more than 200 cases of surgical treatment of this degenerative spine pathology, including all of its segments, have been reported in the literature [1, 2, 17]. Despite a rather large number of publications, each of them describes the series of problems the authors encountered. First of all, they include the question of preoperative verification of hernias. Intradural localization of the intervertebral disc fragment is correctly interpreted at the preoperative stage only in isolated cases. The second important problem is the surgeon's strategy and tactics during surgery in case when the morphological substrate does not correspond to the data of preoperative diagnostics. The question arises on the need for intraoperative ultrasound examination, myelography and revision of the subdural space.

Therefore, despite of modern possibilities of pre- and intraoperative diagnostics, underestimation of the possible intradural localization of the fragment of intervertebral disc herniation can cause significant difficulties during surgery and increase the chance of revision interventions.

Patient Ts., 51 years of age, was admitted from the neurological hospital to the neurosurgery department № 2 of Novosibirsk Research Institute of Traumatology and Orthopaedics on 02.09.2015 with complaints of moderate pain in the lumbar spine, weakness in the legs, impaired urination. Medical history of the patient showed that pain in the lumbar spine and right leg appeared in 2012. Pain syndrome completely regressed against conservative treatment conducted by a neurologist outpatiently. Relapse of pain in the lumbar spine and right leg was noted on 17.08.2015. The patient did not apply for medical help. Weakness in the legs increased, urine retention appeared in 30.08.2015. The patient was hospitalized at the neurological hospital, where a herniated L3–L4 intervertebral disk was diagnosed, which caused the development of caudomedullary syndrome. The patient was transferred to the Research Institute of Traumatology and Orthopaedics.

Traumatology and orthopedics status. Lumbar lordosis is smoothed, paravertebral muscle tension is symmetrical, palpation of interstitial spaces and paravertebral points is painful in the lower lumbar spine.

Neurological status. Leg muscle strength is reduced: to 0 point for extensors of both feet, to 1 and 0 point for the flexors of the left and right foot, respectively, to 4 and 3 points for extensors of the left and right leg, respectively, to 4 points for the right hip flexors, to 2 points for tibial flexors and for the flexors of both hips. Leg muscle tone is low. Knee, Achilles and plantar reflexes are absent on both sides. Hypesthesia and anesthesia were noted in the zone of dermatomes from L2 to S5 on both sides. Pelvic organ function is disturbed

Fig.
MRI of the patient Ts., 51 years of age, with intervertebral disc herniation at L3–L4 level with transdural migration of the fragment: **a** – sagittal plane; **b** – axial plane

by peripheral type (urine is taken by the Foley catheter).

The patient underwent MRI of the lumbar spine (Fig.), which revealed median hernia at the L3–L4 intervertebral disc.

Based on clinical examination and neuroimaging data, the patient was diagnosed with osteochondrosis of the lumbar spine with predominant lesion of the L3–L4 segment, median hernia of the L3–L4 intervertebral disc with left-sided lateralization, caudomedullary syndrome.

A surgical intervention was performed 2 hours after hospitalization: L3–L4 interlaminectomy on the left side, resection of the yellow ligament, the L4 spine was displaced medially. However, the volume of the visualized hernial fragment did not correspond to the volume represented on the MRI scans. Connector-tissue adhesions were found between the ventral surface of the dural sac and the fibrous ring. A slight outflow of liquor and appearance of tissue corresponding macroscopically to the pulpous nucleus occurred during meningoradiculosis. Pulling over the edge of this fragment showed that its main part is located intradurally. It was extracted from the dural sac through a defect on its ventral surface. There was an abundant outflow of cerebrospinal fluid with a spinal cord roots event. The roots are inserted into the cavity of the dural sac. Repairation of the defect in the dura mater was not possible due to its ventral localization. The plastic surgery was performed using fibrin glue and subcutaneous fat, after which the liquorrhea was stopped. The wound was sutured tightly, layer by layer.

Intradural location of the main part of the fragment was shown upon pulling the edge of it. The fragment was separated from the dural sac through the defect on its ventral surface. An abundant outflow of cerebrospinal fluid occurred with eventration of the spinal cord roots. The roots were inserted into the dural sac cavity. Suturation of the defect in the dura mater was not possible due to its ventral localization. Plastic surgery was performed using fibrin glue and subcutaneous fat, after which the liquorrhea stopped. The wound was sutured tightly, layer by layer.

No complications were noted during the postoperative period. The patient was allowed to sit on the second day after the surgery. His activity was limited to the existing neurological deficit. The patient underwent vascular, neurostimulating therapy, physiotherapy, exercise therapy. No regression of neurological deficit was noted at the Unit of neuro orthopaedics. Lower flaccid paraparesis was preserved, it was more rough in the distal parts. Peripheral function of the pelvic organs was disrupted. The patient was transferred to the rehabilitation department on day 7 after surgery.

Follow-up examination after 6 months was not possible since the patient was a citizen of a different country. Interviewing by the phone revealed regression of the neurological deficit: the legs became stronger, the patient walked with the help of a cane. Bladder functions were restored 1 month after surgery.

Discussion

Despite the fact that operable intervertebral disc hernias are the most frequent variant among degenerative spinal lesions, cases with transdural migration of the fragments are quite rare. Statistically, 92 % of these cases are lumbar hernias, 5 % of them are thoracic, and 3 % are cervical. Intradural migration of fragments in the thoracic spine reaches 12–15 % among hernias of this localization. As for the lumbar spine, the prevalence distribution for the segments is the following: 55 % of the cases for L4–L5 level, 16 % for L3–L4 level, 10 % for L5–S1 level, and 19 % for L2–L3 and L1–L2 [6]. This distribution is due to the fact that anatomical location of the ventral surface of the dural sac and the posterior longitudinal ligament is the closest at the L4–L5 level, and hernia incidence is the highest [4, 9]. The average age of the patients with intradural hernias exceeds the age of the patients with extradural hernias by about 10 years and equals 50–60 years of age. These hernias occur four times more often in men than in women [8]. According to our data, intradural migration of the fragments of intervertebral disc tissues in hernias of all spinal segments that have been subjected to surgery is 0.02 % and equals 0.03 %.among hernias of the lumbar spine.

The exact pathogenetic mechanism of intradural migration of the intervertebral hernia fragment has not been definitively determined yet. There are a number of hypotheses based on clinical observations and studies of cadaveric material [4, 9]. The most common theory is the formation of connective tissue adhesions between the ventral surface of the dural sac and the posterior sections of the fibrous ring, which are formed after precursory inflammatory processes in the epidural space at the level of degenerated intervertebral disc. Such changes can

result in violation of the strength and elastic properties of the dura mater [14]. Other predisposing causes of intradural migration of the disc tissue are precursory surgeries, trauma, congenital stenosis of the spinal canal, abnormalities of the dura mater, congenital fusion of the dura mater and posterior longitudinal ligament [8, 11, 16, 22]. In our observation case, the patient had epidural fibrosis, which had probably developed after discoradic conflict, which was registered in the patient's medical history.

Clinical manifestations of intradural hernias are usually more severe than in case of extradural hernias. This pathology of intervertebral discs leads to the development of paraparesis of varying severity, tetraparesis, and Brown-Sequard syndrome caused by compression ischemic myelopathy in almost all patients with cervical and thoracic localization [5, 19]. In case of transural migration of the hernial fragment at the lumbar spine, the compressive clinical symptoms are similar to those in the extradural localization. However, the incidence of rough manifestations in the form of caudomedullary syndrome is much higher and reaches 60% while, on the contrary, it reaches 0.5–1 % in typical hernias [8, 9, 13, 21, 24]. There are still no clearly indicated causes of the high incidence of rough clinical manifestations of these hernias. The fragment migrating into the intradural space is assumed to have significant kinetic energy, which causes mechanical damage to the vascular-neural formations. Another theory is based on the release of the pulpous nucleus of chemical compunds by the tissue that have a toxic effect on the spinal cord roots [9]. Therefore, possible intradural localization of the hernia should be taken into account when dealing with such clinical manifestations caused by intervertebral hernia at the lumbar spine.

Despite the use of high-quality neuroimaging devices, preoperative diagnosis of the discussed pathology in most cases cannot indicate the location of the intervertebral disc fragment relative to the dura mater. Generally, transdural migration of the hernial sequestrum is determined intraoperatively, which dictates the need for correction of surgical tactics [9]. Intradural hernial fragment can be suspected by the presence of gas bubbles within the dural sac on a CT scan [10]. According to MRI data, transdural migration of disc tissue can be indicated by its adherence to the posterior wall of the spinal canal, thickened cuff of the spinal cord, the hawk's beak symptom (a pointed hernia consisting of dense closing plates) [6, 15]. Mut et al. [18] in 2001 suggested dividing these hernia into two types depending on localization of the sequester inside the dural sac: A the hernia is located inside the dural sac; B the hernia is located preganglionically inside the dural sac in the nerve root cuff. Intraradicular localization of the herniated disc fragment was first described in 1984 by Barbera et al. [3]. Afterwards, there have been 22 cases reported in the literature [1]. Differential diagnosis of these hernias is performed alongside with synovial, perineural, and meningic cyst, abscess, benign tumor or hematoma, as well as excessive nerve root [15, 23].

Intradural localization of herniated disc fragment often remains unverified even intraoperatively. This is due to a number of reasons: the defect is localized on the surface of the dural sac that is difficult to visualize, its possible scarring by the time of surgery, cranial or caudal migration of the intradural fragment after examination, which is often the case in its lumbar localization [7, 20]. These factors cause a high incidence of revision interventions in these types of intervertebral hernias. As a result, final diagnosis of intradural migration of the fragment of herniated intervertebral disc can be established only intraoperatively.

A surgeon may face the issue of the cause of dissonance between visualization data and the data of preoperative MRI when finding a discrepancy between them during surgery. The absence of an intervertebral disc fragment can be caused either by migration of the fragment, including transdural migration, or by its lysis. In order to exclude the latter variant, the patient must undergo control MRI examination on the day before surgery, which should be necessarily repeated after surgical intervention in case of intraoperative discrepancy between the hernia volume and neuroimaging data or in the absence of neurological deficit regression after surgery [6]. Surgical tactics in case of detection of intradural migration of the fragment is most cases limited to durotomy, removal of hernia fragments and plastic surgery of the defect of the dura mater. Suturing of the defect on the ventral surface of the dural sac with dorsal access is impossible in most cases due to the difficulty of visualization and the small surgical field. If a detailed inspection of the defect that is difficult to visualize is necessary, expand operational access should be expanded, while sacrificing the stability of the vertebral-motor segment [16]. If possible, the defect should be closed with a special glue, hemostatic material, auto-muscle or auto-fat graft [9, 12]. Noncompliance of these requirements can result in liquorrhea, especially at the thoracic and cervical levels. Choi et al. [6] suggest surgical intervention from ventral access in the case of an accurately diagnosed transdural hernia of the intervertebral disc and argue this tactic with a minimal iatrogenic traumatic effect on the dural sac and, therefore, the roots of the spinal cord, and the possibility of more reliable plastic surgery for the dura mater defect.

Conclusion

Intervertebral disc hernias with transdural migration of their fragments are pathology of the spine that is hard to verify, even intraoperatively, despite the available modern high-quality diagnostic methods. Clinical manifestations are characterized by a high incidence of severe neurological deficit, regardless of severity. Surgical intervention in this pathology involves a number of difficulties: determining the type of surgical access, visualization of the hernial fragment, the need for durotomy, the need for and the volume of stabilization of the affected vertebral-motor segment.

References

1. **Akhaddar A, Boulahroud O, Elasri A, Elmostarchid B, Boucetta M.** Radicular interdural lumbar disc herniation. Eur Spine J. 2010;19 Suppl 2:S149–S152. DOI: 10.1007/s00586-009-1200-9.
2. **Almond LM, Hamid NA, Wasserberg J**. Thoracic intradural disc herniation. Br J Neurosurg. 2007;21:32–34. DOI: 10.1080/02688690601170650.
3. **Barbera J, Gonzalez-Darder J, Garcia-Vazguez F.** Intraradicular herniated lumbar disc. Case report. J Neurosurg. 1984;60:858–860.
4. **Blikra G.** Intradural herniated lumbar disc. J Neurosurg. 1969;31:676–679.
5. **Borm W, Bohnstedt T.** Intradural cervical disc herniation: case report and review of the literature. J Neurosurg Spine. 2000;92(2 Suppl):221–224.
6. **Choi J, Lee W.** Intradural lumbar disc herniation – Is it predictable preoperatively? A report of two cases. Spine J. 2007;7:111–117. DOI: 10.1016/j.spinee.2006.02.025.
7. **Daffner SD, Sedney CL, Rosen CL.** Migratory intradural disk herniation and a strategy for intraoperative localization. Global Spine J. 2015;5:55–58. DOI: 10.1055/s-0034-1381728.
8. **D'Andrea G, Trillo G, Roperto R, Celli P, Orlando ER, Ferrante L.** Intradural lumbar disc herniations: the role of MRI in preoperative diagnosis and review of the literature. Neurosurg Rev. 2004;27:75–82. DOI: 10.1007/s10143-003-0296-3.
9. **Ducati LG, Silva MV, Brandao MM, Romero FR, Zanini MA.** Intradural lumbar disc herniation: report of five cases with literature review. Eur Spine J. 2013;22 Suppl 3:S404–S408. DOI: 10.1007/s00586-012-2516-4.
10. **Hidalgo-Ovejero AM, Garcia-Mata S, Gozzi-Vallejo S, Izco-Cabezon T, Martinez-Morentin J, Martinez-Grande M.** Intradural disc herniation and epidural gas: something more than a casual association? Spine. 2004;29:E463–E467. DOI: 10.1097/01.brs.0000142433.21912.0d.
11. **Jain SK, Sundar IV, Sharma V, Goel RS, Gupta R.** Intradural disc herniation – a case report. Turk Neurosurg. 2013;23:389–391. DOI: 10.5137/1019-5149.JTN.5437-11.1.
12. **Kansal R, Mahore A, Kukreja S.** Cervical intradural disc herniation and cerebrospinal fluid leak. Neurol India. 2011;59:447–450. DOI: 10.4103/0028-3886.82771.
13. **Kardaun JW, White LR, Shaffer WO.** Acute complications in patients with surgical treatment of lumbar herniated disc. J Spinal Disord. 1990;3:30–38.
14. **Kim HS, Eun JP, Park JS.** Intradural migration of a sequestrated lumbar disc fragment masquerading as a spinal intradural tumor. J Korean Neurosurg Soc. 2012;52:156–158. DOI: 10.3340/jkns.2012.52.2.156.
15. **Kim JS, Lee SH, Arbatti NJ.** Dorsal extradural lumbar disc herniation causing cauda equina syndrome: a case report and review of literature. J Korean Neurosurg Soc. 2010;47:217–220. DOI: 10.3340/jkns.2010.47.3.217.
16. **Kobayashi K, Imagama S, Matsubara Y, Yoshihara H, Hirano K, Ito Z, Ando K, Ukai J, Muramoto A, Shinjo R, Matsumoto T, Nakashima H, Ishiguro N.** Intradural disc herniation: radiographic findings and surgical results with a literature review. Clin Neurol Neurosurg. 2014;125:47–51. DOI: 10.1016/j.clineuro.2014.06.033.
17. **Krajewski K, Regelsberger J.** Intradural lumbar disc herniation associated with degenerative spine disease and rheumatoid arthritis. Spine. 2013;38:E763–E765. DOI: 10.1097/BRS.0b013e31828daa8c.
18. Mut M, Berker M, Palaoglu S. Intraradicular disc herniations in the lumbar spine and a new classi cation of intradural disc herniations. Spinal Cord. 2001;39:545–548.
19. Parnell AP. Cervical intradural disc protrusion. J Neurol Neurosurg Psychiatry. 1988;51:1007.
20. Sarlieve P, Delabrousse E, Clair C, Hussein HH, Schmitt C, Kastler B. Intradural disc herniation with cranial migration of an excluded fragment. Clin Imaging. 2004;28:170–172. DOI: 10.1016/S0899-7071(03)00147-5.
22. Shapiro S. Medical realities of cauda equina syndrome secondary to lumbar disc herniation. Spine. 2000;25:348–351. DOI: 10.1097/00007632-200002010-00015.
22. Tamaki Y, Sakai T, Miyagi R, Nakagawa T, Shimakawa T, Sairyo K, Chikawa T. Intradural lumbar disc herniation after percutaneous endoscopic lumbar discectomy: case report. J Neurosurg Spine. 2015;23:336–339. DOI: 10.3171/2014.12.SPINE14682.
23. Yang SM, Park HK, Cho SJ, Chang JC. Redundant nerve roots of cauda equina mimicking intradural disc herniation: a case report. Korean J Spine. 2013;10:41-43. DOI: 10.14245/kjs.2013.10.1.41.
24. **Yildizhan A, Pasaoglu A, Okten T, Ekinci N, Aycan K, Aral O.** Intradural disc herniations pathogenesis, clinical picture, diagnosis and treatment. Acta Neurochir (Wien). 1991;110:160–165. DOI: 10.1007/BF01400685.

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